Environmental Impact Analysis Process

FINAL

ABBREVIATED ENVIRONMENTAL ASSESSMENT FOR P91-1 ARGOS SPACECRAFT

VANDENBERG AIR FORCE BASE, CA

June 1997

DEPARTMENT OF THE AIR FORCE

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ENVIRONMENTAL IMPACT ANALYSIS PROCESS

P91-1 ARGOS SPACECRAFT
ABBREVIATED ENVIRONMENTAL ASSESSMENT

Prepared for

Headquarters, Space and Missile Systems Center
Los Angeles AFB, CA

Prepared by

The Aerospace Corporation and
Space and Missile Systems Center
El Segundo, CA 90245

FINDING OF NO SIGNIFICANT IMPACT (FONSI)
P91-1 ARGOS SPACECRAFT PROGRAM
VANDENBERG AFB, CA

AGENCY: United States Air Force, Headquarters Space and Missile Systems Center (SMC).

COOPERATING AGENCIES: United States Air Force Space Command (SPACECOM).

ACTION: Proposed development, manufacture, and operation of a single research and development spacecraft to be launched on a Delta II launch vehicle. The spacecraft is called P91-1 ARGOS (Advanced Research and Global Observation Satellite).

BACKGROUND: A contract for development of the ARGOS spacecraft was awarded by SMC in 1991 to Rockwell International Corporation, Seal Beach, California. The expendable design capability of the spacecraft is intended to carry out a one year mission of scientific observation. It is proposed that the spacecraft with its integrated experiment payload to be launched into a 460 nautical mile orbit on a Delta II Model 7920 launch vehicle from Vandenberg AFB in CY 97.

FINDINGS: There were no significant impacts to the environment identified in the Environmental Assessment (EA) for the P91-1 ARGOS. Therefore, this action qualifies for a Finding of No Significant Impact (FONSI) as described in AFI 32-7061, Environmental Impact Analysis Process. The Environmental Assessment describing the proposed action is on file at:

Department of the Air Force
Headquarters, SMC/AXFV
Attn: Thomas Huynh, GS-09
2420 Vela Way, Suite 1467
Los Angeles Air Force Base
El Segundo, CA 90245-4659

APPROVED: HQ SMC Environmental Protection Committee (EPC)

JOHN L. CLAY
Brigadier General, USAF
Chairperson, Environmental Protection Committee

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ABBREVIATIONS AND ACRONYMS

Ar	Argon (atomic symbol)
AFB	Air Force Base
AFMC	Air Force Materiel Command
AFSLV	Air Force Small Launch Vehicle (Pegasus XL)
AFSPC	Air Force Space Command
Ag-Zn	Silver-Zinc (atomic symbols) as electrodes in a battery
ARTS	Automated Remote Tracking Station
CCC	California Coastal Commission
CCD	Coastal Consistency Determination
CEV	USAF/SMC Directorate of Acquisition Civil Engineering, Environmental Management Division
CIV	Critical Ionization Velocity (an ARGOS payload)
CO_2	Carbon Dioxide (chemical formula)
COCO	Contractor-Owned Contractor-Operated
COBE	COsmic Background Explorer
DOPAA	Description of Proposed Action and Alternatives
DOT	U.S. Department of Transportation
DSCS	Defense Support Communications System
EA	Environmental Assessment
EIAP	Environmental Impact Analysis Process
EPC	Environmental Protection Committee
EPCRA	Emergency Planning and Community Right-To-Know Act
ESA	Endangered Species Act
ESEX	Electric Propulsion Space Experiment (an ARGOS payload)
EUVIP	Extreme Ultraviolet Imaging Photometer (an ARGOS payload)
Fe^{55}	A radioactive isotope of Iron with an atomic weight of 55
GEO	Geosynchronous Earth Orbit
GSE	Ground Support Equipment
GIMI	Global Imaging Monitor of the Ionosphere (an ARGOS payload)
GPS	Global Positioning System
HCl	Hydrochloric Acid or Hydrogen Chloride (chemical formula)
He	Helium (atomic symbol)
HIRAAS	High Resolution Airglow/Auroral Spectrograph (an ARGOS payload)
HTSSE	High Temperature Superconductivity Space Experiment (an ARGOS payload)
IEU	Integrated Electronics Unit
IRP	Installation Restoration Program
LEO	Low Earth Orbit
NASA	National Aeronautics and Space Administration
NH_3	Ammonia (chemical formula)

NiH_2	Nickel Hydride (chemical formula)
NM	Nautical Miles
NMFS	National Marine Fisheries Service (a section of NOAA/Dept. of Commerce)
NOAA	National Oceanic and Atmospheric Administration
ODS	Ozone-Depleting Substances
SBCAPCD	Santa Barbara County Air Pollution Control District
SGLS	Space-Ground Link System
SLC	Space Launch Complex
SPADUS	Space Dust Experiment (an ARGOS payload)
STEP	Space Test Experiment Platform (a small modular experiment satellite)
TBD	To be determined
TT&C	Telemetry, Tracking and Commanding
USA	Unconventional Stellar Aspect (an ARGOS payload)
USAF	United States Air Force
USFWS	United States Fish and Wildlife Service (a section of the Department of the Interior)
VAFB	Vandenberg Air Force Base
WR	Western Range
Xe	Xenon (atomic symbol)
30 SPW	30th Space Wing, a unit of AFSPC

1.0 PURPOSE of and Need for the Action

1.1 Proposed Action:

The proposed action is to develop, manufacture, and launch an on-orbit operation of a single P91-1/ARGOS (hereinafter called ARGOS) spacecraft. All ARGOS (Advanced Research and Global Observation Satellite) manufacturing and pre-launch servicing and checkout is carried out in contractor-owned and contractor-operated (COCO) facilities, (not at Vandenberg AFB) using what is known as a "Ship and Shoot" philosophy. The launch of ARGOS will be from Space Launch Complex 2 West (SLC-2W) at Vandenberg AFB. The environmental impacts of the Delta II launch vehicle are described in detail in the NASA/GSFC document: "Environmental Assessment for the Modification of Space Launch Complex 2 at Vandenberg Air Force Base, California", dated September 1991, and a supplement to that EA dated November 1992".

Eight experiments will be conducted for the ARGOS mission. The purposes of these experiments are described in brief as follows:

Critical Ionization Velocity (CIV) will study ionization processes caused by molecular collisions in the upper atmosphere. This will help in the identification of rocket plumes and wakes by ground or space sensors. Sponsor: USAF Phillips Laboratory.

Extreme Ultraviolet Imaging Photometer (EUVIP) will establish the behavior of the upper atmosphere and the plasmasphere as needed for RF systems design. Sponsor: U.S. Army.

Global Imaging Monitor of the Ionosphere (GIMI) will demonstrate operational sensor technology for environmental monitoring of upper atmosphere perturbations due to meteors, aurora and rocket exhausts. The data will provide DoD users with improved capability to obtain global upper atmosphere weather coverage over large areas. Sponsor: U.S. Navy

High Resolution Airglow/Auroral Spectrograph (HIRAAS) will map upper atmosphere composition and structure in the airglow/auroral region to improve satellite drag forecasting and life prediction. It will also help improve performance of systems involving radio and microwave propagation in this region. Sponsor: U.S. Navy.

Unconventional Stellar Aspect (USA) will characterize astronomical X-ray sources for potential use as autonomous position, attitude and timekeeping references. It will also perform the first X-ray tomographic survey of the Earth's atmosphere. Sponsor: U.S. Navy.

Space Dust Experiment (SPADUS) will provide definitive measurements of the orbital debris in a highly populated DoD altitude/inclination orbit. This will allow prediction of orbital debris "showers" which could affect DoD spacecraft as well as Space Shuttle and Space Station Freedom. It will also help spacecraft shielding and electronics design for extended lifetimes. Sponsor: U.S. Navy.

Electric Propulsion Space Experiment (ESEX) will demonstrate crucial arcjet thruster propulsion technology needed to support cost effective access to space. Such upper stages can double the payload-to-orbit capability of expendable boosters, greatly reducing launch costs. Sponsor: USAF Phillips Laboratory.

High Temperature Superconductivity Space Experiment (HTSSE II) is intended to demonstrate the effectiveness of superconductive device technology in spacecraft. The benefits are expected to be operating speeds over 10 times greater than conventional devices, power requirements 100 to 1000 times less, and weight reductions of 10 times less. It will also demonstrate an advanced cryocooler for cooling focal plane arrays and semiconductors. Sponsor: U.S. Navy

1.2 Need for the Proposed Action:

The mission responds to the periodic need to fly experiments which are too large, heavy or high in power requirements for other launch systems available to the Air Force Space Test Program, such as the Air Force Small Launch Vehicle (AFSLV) and the Space Test Experiment Platform (STEP) satellite. This spacecraft is intended to provide cost effective access to space for space experiments provided by the U.S. military services through the Tri-Service Board.

1.3 Decision That Must Be Made:

The decision that must be made is what action to take to provide eight space experiments that are essential to the AF space program. This decision will be based on cost and the capability of each alternative to meet the minimum mission requirement, while considering the level of potential environmental impact of each alternative.

2.0 DESCRIPTION OF PROPOSED ACTION AND ALTERNATIVES (DOPAA)

2.1 The Proposed Action

The ARGOS spacecraft consisting of the ARGOS spacecraft bus and the eight experiment hardware packages will be designed, fabricated and integrated into a launch assembly at the Rockwell International Corporation, Seal Beach, California. It is then proposed that this launch vehicle/payload assembly be launched from Space Launch Complex SLC-2W at Vandenberg Air Force Base, California at an azimuth of 196^{o}. After reaching orbit, it is proposed that the spacecraft and its experiment payload perform a series of scientific observations and experiments as described in this section and Section 1.0 for a period of approximately one year.

The subject launch is scheduled in CY 97 using a Delta II Model 7920 vehicle. The intended orbit is 460 (+0, -10) nautical miles (NM) at an inclination of 98.74^{o}. Figure 2-1 depicts the ARGOS spacecraft and its subsystems. Figure 2-2 depicts the ARGOS experiments, their appearance and locations on the spacecraft. Figure 2-3 presents an exploded view of the Delta II launch vehicle with the ARGOS spacecraft integrated in the payload fairing.

2.1.1 The ARGOS spacecraft subsystems:

Structure subsystem consists of a two bay rectangular frame, using aluminum structure with aluminum honeycomb external panels and internal bulkheads. It is provided with a 4-hardpoint launch vehicle interface to match the Delta standard payload adapter. Experiment mountings and locations are selected to maximize the experiment fields of view.

Telemetry, Tracking and Commanding (TT&C) subsystem consists of a 2-carrier RF system, compatible with ARTS and SGLS ground stations, for uplink telecommanding of the spacecraft as well as downlinking experiment data. Both uplink and downlink are encrypted, and a 2.4 gigabit on-board recording capability is provided for data obtained between ground station downlink opportunities.

Thermal Control subsystem is a cold-biased system consisting of multilayer insulation, radiators, doublers and thermal control coatings. Make-up heaters are included to allow for cold-case attitudes and conditions.

Digital subsystem performs control of data management functions, attitude and sun safe requirements, data recorder, telemetry, thermal sensing/processing as well as decoding and distribution of commands from the TT&C subsystem. Its

hardware is contained in an Integrated Electronics Unit (IEU) with 8 modules, one of which is a Global Positioning System (GPS) receiver.

Power subsystem provides 1000 watts of 28V DC bus power for the operation of spacecraft subsystem and experiment equipment. The subsystem consists of a Load Control Unit, a Power Conditioning Unit, a battery assembly with two 45 amp-hour nickel hydride batteries, and a pair of solar arrays with drive mechanisms. The silicon cell solar arrays provide power to the spacecraft bus as well as to recharge the batteries for eclipse operation. Hazardous materials used are identified and assessed in Reference (5).

Attitude Determination and Control System (ADACS) provides attitude knowledge, attitude stabilization and maneuver capability to the spacecraft. The subsystem consists of two Inertial Reference Units, two Scanning Horizon Sensors, a set of four Reaction Wheels, six analog Sun Sensors and two electromagnets for magnetic moment compensation. Inputs from the sensors are combined with GPS data in the Integrated Electronics Unit. Reaction wheel torque, electromagnet on/off commands and RCS thruster commands are then generated as required.

Propulsion (Reaction Control) subsystem provides attitude maneuvering capability for sun safe operation, under the control of the ADACS subsystem. Eight 0.2 lbf thrusters utilize CO_2 gas from tanks shared with the CIV experiment. The thrusters, positioned about three orthogonal axes, provide attitude control capability.

2.1.2 The ARGOS Spacecraft Hazardous Materials:

All ARGOS manufacturing and pre-launch servicing and checkout are carried out in contractor-owned and contractor-operated facilities. The ARGOS spacecraft and its experiments contain a number of chemicals, specifically carbon dioxide, xenon, P10 gas (10% methane, 90% argon), argon, methane, helium and ammonia gases, small amounts of the radioisotope Fe^{55}, as well as chemicals associated with the silver/zinc and nickel hydride batteries. The P91-1 ARGOS contractor, Rockwell International, is pursuing a corporate policy to reduce the usage of toxic and hazardous materials on P91-1 and all of their programs. One such project, for example, is aimed at reducing dependence on the use of chromate (hexavalent chrome) corrosion control materials. Rockwell is one of the corporations committed to eliminate the EPA-17 (EPA 33/50) in all of the process. Safety analyses of the operations, equipment and subsystems involving these materials have been performed, and have shown that potential environmental and personnel hazards have been effectively precluded.

2.2 Alternatives to the Proposed Action

In the planning of this set of experiments, a study was performed on alternative ways in which they could be flown. These are summarized below.

2.2.1 Using an excess spacecraft bus

An inventory of available spacecraft buses was reviewed. These include DSCS-3, DSCS-2, GPS Block 2, COsmic Background Explorer (COBE) and Teal Ruby. Using the planned Delta II booster, these buses could all be refurbished and the eight experiments could be integrated, and launched. However, it was concluded that, due to the uncertain pedigree of the hardware and that they were designed for other missions, the cost of refurbishing and integrating to the ARGOS experiments would be greater than developing and building the P91-1 ARGOS spacecraft. Furthermore, with the exception of Teal Ruby and the COBE bus, it is unlikely that any existing bus would be able to accommodate the weight of all eight experiments - now almost 3000 lbs.

2.2.2 Using the TITAN IV or the NASA STS (Shuttle)

The Titan IV program has evolved rapidly since 1985 when the USAF began the Complementary Expendable Launch Vehicle (CELV) program to provide launch capability to supplement the Space Shuttle. Both the TITAN IV and Space Shuttle are able to provide large lift capacity to ensure adequate launch capability for DoD and commercial heavy payloads. But, the TITAN IV and the Space Shuttle would cost more to provide the same service. The Delta II is a much more efficient vehicle and it is able to accommodate the ARGOS mission with little modification . Using the Delta II provides less impact to the environment and significantly reduces the operating cost of the mission. Therefore, the TITAN IV and the Space Shuttle are both exempt from further study.

2.2.3 Fly experiments on STEP

STEP (Space Test Experiment Platform) is a small modular experiment satellite and is mainly designed for a single low mass experiment. Each of the eight experiments could be individually flown with minor bus modifications on separate STEP missions. However, the $25-30M cost of each mission make these economically unattractive alternatives. Also, three of the eight experiments require a high inclination orbit at 450 NM, and it is questionable if Pegasus (the STEP launch vehicle) would have adequate performance.

2.3 No Action Alternative

The eight experiments which compose the payload of ARGOS have been reviewed by the Tri-Service Board, an Army-Navy-Air Force board which annually reviews all DoD-sponsored space experiments for mission relevance and value, and prioritizes them. This Board ranked the experiments as follows:

HTSSE II	#2 (1992)
HIRAAS	#5 (1991)
GIMI	#19 (1991)
USA	#22 (1991)
EUVIP	#8 (1991)
CIV	#9 (1991)
ESEX	#13 (1990)
SPADUS	#33 (1990)

These rankings illustrate the relative importance of the experiments, with some of the lesser ranked (higher numbered) experiments being included to efficiently utilize the spacecraft capacity. Because of the high priority attached to these experiments, the No Action Alternative is not acceptable.

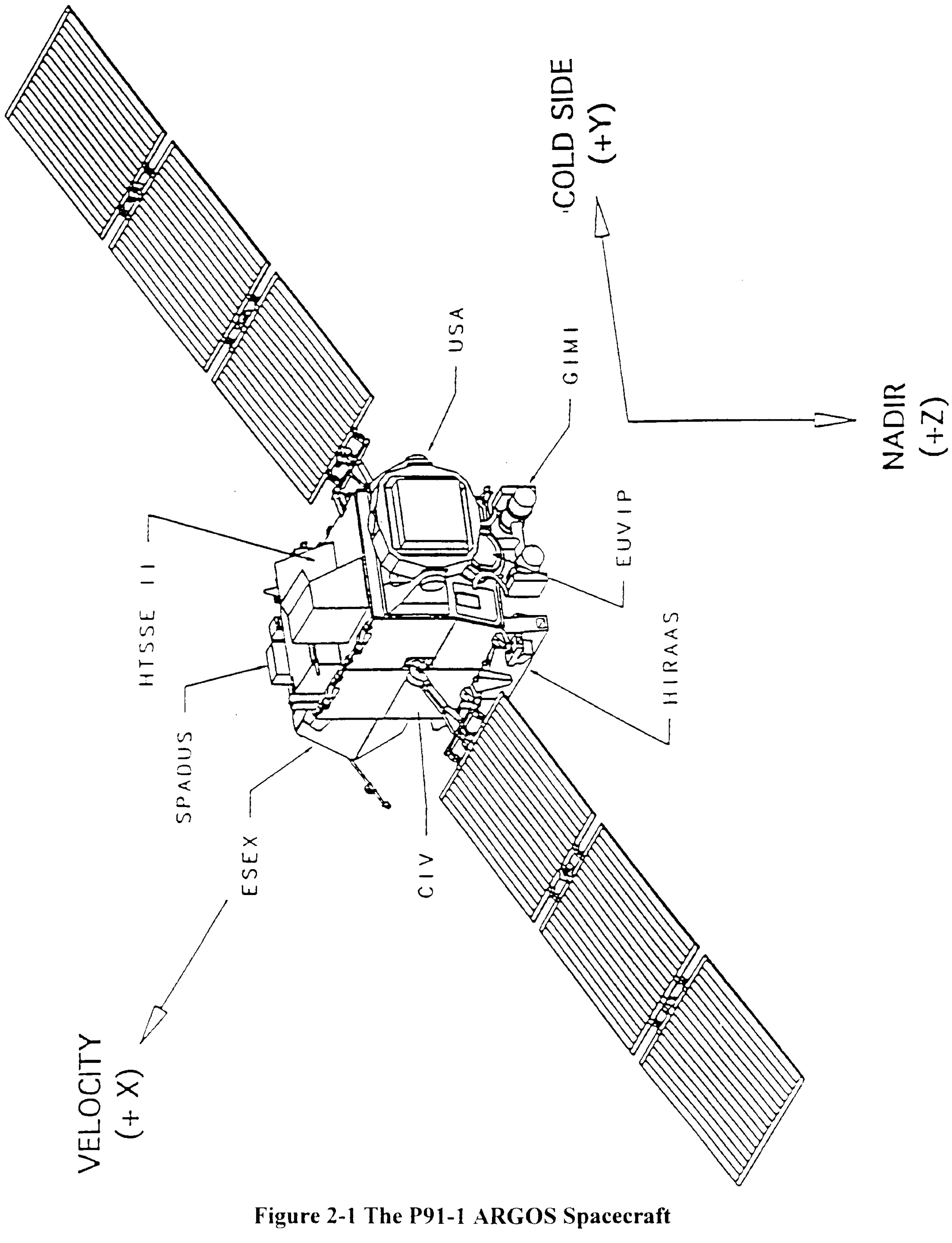

Figure 2-1 The P91-1 ARGOS Spacecraft

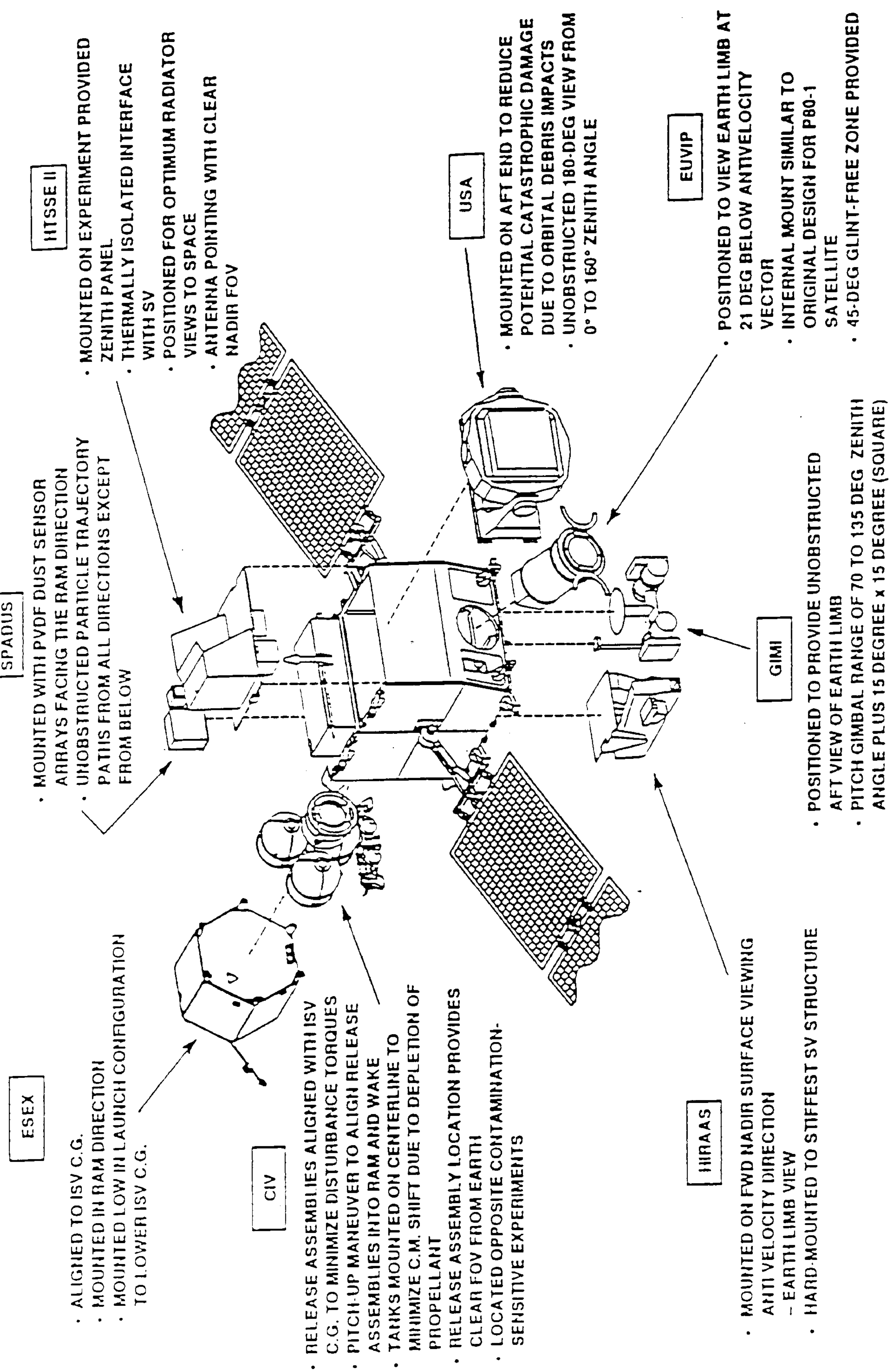

Figure 2-2 P91-1 ARGOS Experiments

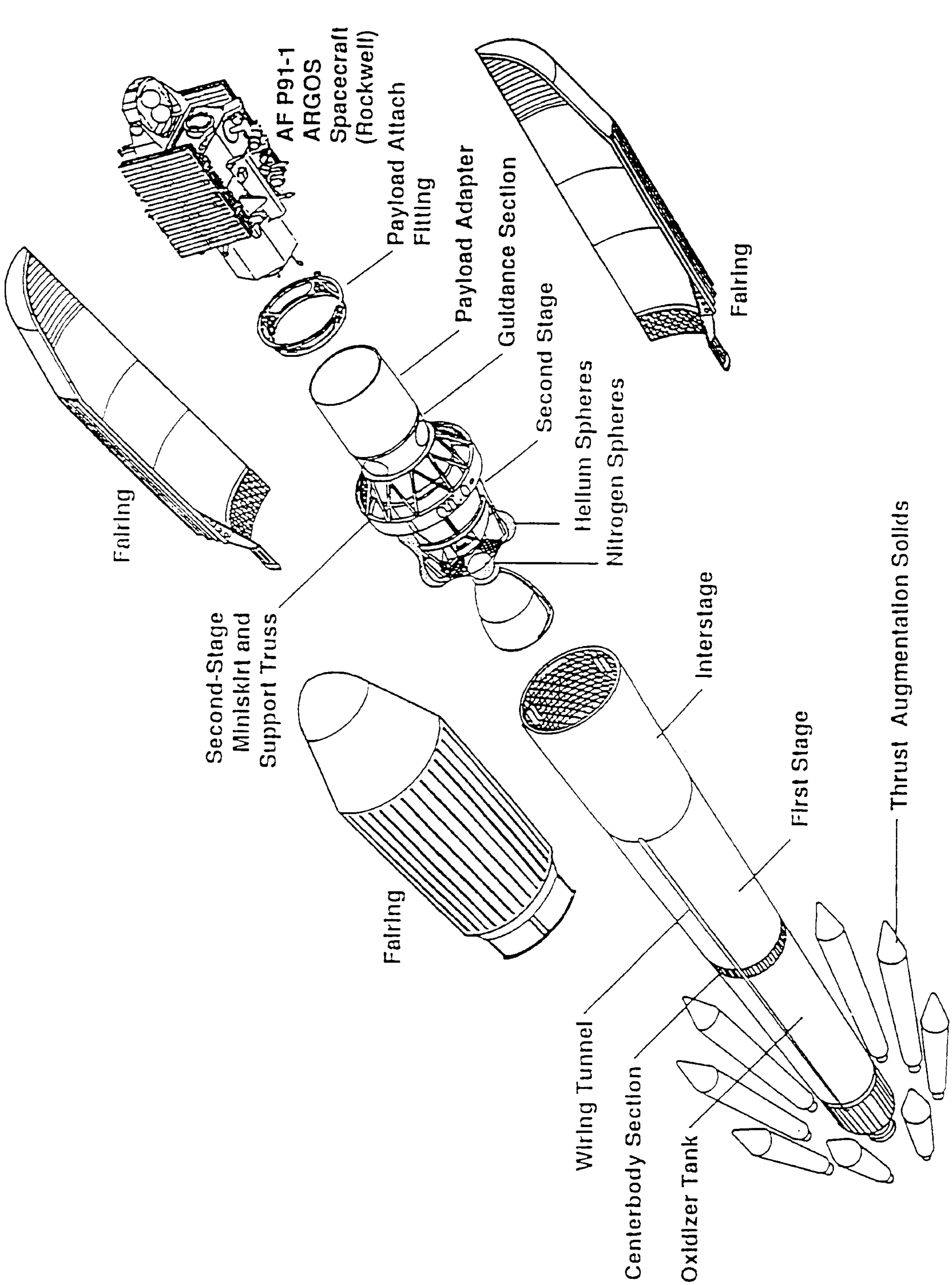

Figure 2-3 Delta II Launch Vehicle

3.0 AFFECTED ENVIRONMENT

The affected environment for the ARGOS mission consist of the contractor-owned facilities, the launch site, the Western Range (WR), and the space environment in which ARGOS orbital operations occur. The contractor owned facilities are excluded from this environmental assessment because the government is not responsible for actions that take place at contractor-owned contractor-operated (COCO) facilities. The launch site and the WR are extensively described in Section 3.0 of the Environmental Assessment of the Delta II Program, Reference (1), and the Supplemental Environmental Assessment for Delta II, Reference (2), which resulted in a FONSI. The operational space environment for the satellite is the only environment that will be considered for this EA.

Space Debris

The United States, the former Soviet Union and other nations have been launching hardware into space since the 1950s, and certain regions of space are getting crowded not only with satellites, but also useless hardware such as booster stages and miscellaneous bits and pieces of separation hardware, fragments of exploded tankage. There are several implications from this situation. First, there is an increasing risk with attendant damage or crew safety problems of debris collision with an operational satellite or a manned vehicle such as Shuttle or Space Station. This is particularly true in the most "popular" orbits, such as the Low Earth Orbit (LEO), and the Geosynchronous Earth Orbit (GEO). LEO is at altitudes less than 2,000 km with orbital periods less than 3.75 hours. GEO is occupied by objects orbiting at an altitude of approximate 35,787 km with an orbital period of approximately twenty-four hours. Secondly, large or very dense items of debris can deorbit with time, survive reentry and cause the risk of damage on the Earth's surface. And third, deorbiting debris which burns up during reentry can deposit particulate matter (metal oxides) in the stratosphere, aggravating the suspected effect on ozone depletion. NASA has reported a tenfold increase in the metals content of the stratosphere in the last few years (Reference 6).

The statistical probability of collision between orbiting debris and a large satellite such as the Shuttle or Space Station has been studied, based on the ephemeris of tracked debris maintained by AFSPC (Reference 3). This work estimated that collisions would occur every 1980 years in a 28.5 degree inclination orbit at a 400 km. altitude. The probability of a deorbiting object causing human injury has also been studied (Reference 4). It was concluded that injury from a deorbiting satellite had a Daily Casualty Expectation (DCE) of 0.16×10^{-4}, while the same figure for injury from a booster (during launch or ascent) was 0.2×10^{-5} to 0.9×10^{-4}. In medical and toxicological risk assessments, a probability of 10^{-6} is often considered the break point between what is and what is not socially acceptable. Hence, this level of risk may be sufficient to warrant

concern and prompt action. Studies are currently in progress to quantify the effects of the third phenomenon - particulate deposit from reentering debris.

4.0 ENVIRONMENTAL CONSEQUENCES AND MITIGATION

The impacts from the launch vehicle and its operations are not discussed here, since they are discussed in detail in section 4 of references (1) and (2). The only impact discussed in detail in the space element is Space Debris.

Space Debris

The ARGOS spacecraft consists of a single spacecraft body, which will not deploy any separate hardware but remain intact. It is mated to the launch vehicle Payload Attach Fitting by four explosive nuts. A secondary latch system retains the spacecraft immediately after the nuts have been fired for about 30 seconds. The four secondary latches are held closed by a single cable which is severed by an explosive charge, thus opening the four latches simultaneously. After latch opening, the Delta vehicle backs away from the spacecraft by firing helium retrothrusters on the Delta 2nd stage. All elements of this separation system (bolts, nut, latches etc.) are retained with either the spacecraft or the Delta launch vehicle (Reference 5).

The ARGOS spacecraft is intended to perform its mission for one year and then be shut down. The reentry of the 2nd stage and spacecraft could contribute to particulate matter (mostly aluminum oxide) in the stratospheric ozone region. This has become a concern recently as a potential contributor to ozone depletion (Reference 7). However, as stated, research is in progress to define such effects and whether or not they represent an environmental impact. In the meanwhile, no mitigation technology exists to prevent such deposition.

In summary, steps have been taken in the spacecraft and launch vehicle design to minimize the number of pieces of hardware and debris released by the launch. Other debris considerations from eventual reentry and impact of large or high density pieces, as well as the introduction of particulate matter into the stratosphere have not been precluded but are beyond current technology to mitigate.

5.0 PERSONS AND AGENCIES CONTACTED

Agardy, Frederic, The Aerospace Corporation, El Segundo CA (ARGOS experiment payload data)

Chism, Douglas, The Aerospace Corporation, El Segundo, CA (ARGOS Program Manager)

Cirilo, Deborah, The Aerospace Corporation, El Segundo, CA (ARGOS electrical systems data)

Gurevich, Gwynne, The Aerospace Corporation, El Segundo CA (ARGOS mechanical systems data)

Lavelle, Thomas, NASA Goddard Space Flight Center, Huntington Beach Operations Branch (Delta II data and references)

Naydol, Al, Chief of Natural Resources, 30 SPW/CEVN, Vandenberg AFB CA (USFWS requirements)

6.0 REFERENCES

(1) National Aeronautics and Space Administration, "Environmental Assessment - Modification of Space Launch Complex -2W, Medium Expendable Launch Vehicle Services", Vandenberg AFB, CA, September 1991.

(2) National Aeronautics and Space Administration, "Supplemental Environmental Assessment - Modifications and Operations of Space Launch Complex -2W for the Delta II Launch Vehicle", Vandenberg AFB, CA, November 1992.

(3) Vedder, J.D. and J. L. Tabor, "New Methods for Estimating Low Earth Orbit Collision Probabilities", AIAA Journal of Spacecraft Vol. 28 No. 2, March-April 1991.

(4) Refling, O., R. Stern, C. Patz, "Review of Orbital Reentry Risk Predictions", The Aerospace Corporation Technical Report No. ATR-92(2835)-1, 15 July 1992.

(5) Rockwell International Corp., "Phase 2 Accident Risk Assessment Report for the P91-1 Space Vehicle System", 16 April 1993.

(6) Meshishnek, M.J., "Overview of the Space Debris Environment", Aerospace Corporation Technical Report No. TOR-94(4231)-1, 15 May 1994.

(7) Meads, R., Spencer, D., and Molina, M.J., "Stratospheric Chemistry of Aluminum Oxide Particles", Massachusetts Institute of Technology, June 1994.

7.0 LIST OF PREPARERS

This chapter provides the names and qualification of staff members who were primarily responsible for preparation of this EA.

Name	Professional discipline	Experience	Document Responsibility
7.1 Aerospace Corporation			
Norman R. Keegan	Chemistry/Environmental Science	6 yrs Environmental Management and 41 Aerospace	Main Writer
Dr. Valerie I. Lang	Chemistry/Environmental Science	12 Environmental Science	Technical Review
7.2 US Air Force			
Thomas Huynh	Environmental Management	1.5 yrs Environmental Management	Support Writer
Dan Pilson	Environmental Management	12 yrs Environmental Management and 5 yrs Consulting	Technical Review
John Edwards	Environmental Management	20 yrs Environmental Management and NEPA Analysis	Technical Review

APPENDIX A

AF FORM 813
Request for Environmental Impact Analysis

REQUEST FOR E[illegible]RONMENTAL IMPACT ANALYSIS		FOR ENVIRONMENTAL PLANNING USE ONLY
I REQUEST		
1. TO: *(Environmental Planning Function)* SSD/DEV	2. FROM: *(Organization and Office Symbol)* SSD/CLPM	3. CONTROL NUMBER
5. REQUESTOR *(Name, Office Symbol and Phone No.)* Capt BRIAN TURNER, SSD/CLPM,36766		4. ESTIMATED COMP DATE

6. TYPE OF ANALYSIS NEEDED

[ ] CATEX DETERMINATION	[ ] PRELIMINARY ENVIRONMENTAL SURVEY	[X] ENVIRONMENTAL ASSESSMENT	[ ] ENVIRONMENTAL IMPACT STATESMENT

7. TITLE OF PROPOSED ACTION
P91-1 ADANCED RESEARCH AND GLOBAL OBSERVATION SATELLITE (ARGOS)

II PROPOSED ACTION AND ALTERNATIVES

8. PURPOSE OF AND NEED FOR ACTION *(Continued on Sheets)*

The Space Test and Transportation Program Office provides spacecraft and space flights for DOD research and development (R&D) activities. Current acquisitions include the ARGOS mission, which will provide a large spacecraft for heavy experiments that cannot be accommodated by other projects. The experiments are highly ranked Tri-Service board selections of the R&D that most needs to be accomplished. The agencies served by the ARGOS mission are the Air Force Phillips Lab, the Naval Research Lab, the Office of Naval Research, and the Defense Advanced Research Project Agency. Rockwell International, Seal Beach is the prime contractor for the ARGOS mission. The System Design Review was held on 12-14 May 92.

9. DESCRIPTION OF PROPOSED ACTION AND ALTERNATIVES *(DOPAA) (Continued on Sheets)*

ARGOS, a one-time mission, is scheduled to be launched in late FY95 by a Delta II from Vandenberg AFB, California. The ARGOS spacecraft will weigh no more than 6000 lbs. The orbit altitude will be 450 NM at 98.7° inclination. The spacecraft design life is for a minimum of one year with a goal of three years. Spacecraft ground control will be accomplished through the AFSCN and CSTC. The tracking stations used for downlinking will probably all be CONUS. No new facility construction is needed for this program. The ARGOS spacecraft complement includes experiments to observe atmospheric and stellar phenomena, characterize on-orbit dust particles, and demonstrate an electric arcjet propulsion unit and a star-based position and attitude determination system. See attachment for further experiment details.

Alternatives:
1) Accomplish half the results at approximately the same cost. Although half of the experiments could fly on the existing Space Test Experiment Platform (STEP) for about the same cost as the full complement on ARGOS, the other half could not be flown without a MLV. Therefore, some experiments would not be utilized, data would not be obtained, and the resources already invested would not come to fruition.
2) Do not accomplish the mission.

10. ORGANIZATIONAL APPROVAL *(Name and Grade of Commander)*	SIGNATURE	DATE
JAMES G. MILLER, Lt Colonel, USAF Dep Program Manager, Space Test and Transp	James Miller	30 Jun 92

III ENVIRONMENTAL PLANNING RESPONSE

11. RESPONSES ATTACHED

- [ ] Preliminary Environmental survey *(AF Form 814)* attached
- [ ] Proposed action qualified for Catex *(Appropriate Documentation attached)*
- [X] Proposed action does not qualify for Catex, assessment required

12. REMARKS

13. ENVIRONMENTAL PLANNER CERTIFICATION *(Name and Grade)*	SIGNATURE	DATE
THOMAS HUYNH GS-09	Thomas Huynh	26-06-97
14. ENVIRONMENTAL PROTECTION COMMITTEE APPROVAL *(Name and Grade)*	SIGNATURE	DATE

Feb 92

P91-B Experiment List Description

- ADCNS

Attitude Determination Control and Navigation System. Autonomous, cost-effective, lightweight system for detecting position and attitude.

- CIV

Critical Ionization Velocity experiment will study ionization processes caused by molecular collisions in the upper atmosphere. The data product will be used to help characterize the wakes of reentering vehicles, rocket vehicles and spacecraft making maneuvers in the upper atmosphere.

- ESEX

Electric Propulsion Space Experiment will demonstrate that electric propulsion units and their arcjet electrodes will work reliably in vacuum and that they can be used without interfering with electrical, thermal and contamination constraints of the spacecraft.

- EUVIP

High altitude Extreme Ultraviolet Imaging Photometer. Similar to HIRAAS but for higher altitudes and wider viewing area.

- GIMI

Global Imaging Monitor of the Ionosphere will obtain UV images of ionospheric emissions with an altitude profile of ionospheric species.

- HIRAAS

High resolution ultraviolet imager. Examines ionosphere to understand and predict effects of ionospheric variations on communications and OTH radars. UV imaging cannot be done from the ground because UV is absorbed by the atmosphere. End product will be an improved model for predicting effects of ionosphere on communications and eventually a "weather" prediction for the upper atmosphere for operational use.

- HIROI

High Resolution Ozone Imager. Obtains high spatial resolution images of ozone density for determining whether spent fuel from high altitude rockets depletes the ozone layer.

- SPADUS

Space Dust Experiment. Collects and records information on dust particles of natural and man-made origin.

- USA

Unconventional Stellar Aspect Experiment. Investigates use of x-ray pulsars for use as clock timing sources by satellites.

APPENDIX B

Contractor Reports on Hazardous Materials Usage

Space Systems Division
Rockwell International Corporation
12214 Lakewood Boulevard
P. O. Box 7009
Downey, California 90241-7009

Rockwell International

March 23, 1995

In Reply Refer to 95MA1013

Subject: P91-1 ARGOS Contract F04701-91-C-0090, Submittal of Environmental Data

To: Department of the Air Force
HQ Space & Missile Systems Center (AFMC)
160 Skynet Street, Suite 1536A
Los Angeles Air Force Base, Ca 90245-4683

Attention: Ms. Mary S. Hawkins, Contracting Officer, SMC/CULK

Reference:
1) Air Force ltr from Captain R. Lutz to D. Triplett, dated 24 Oct 94
2) Rockwell SSD ltr reference 94MA4211, dated 1 Dec 94
3) Air Force Memo from Capt B. Turner to F. Rotter, dated 21 Dec 94

Up-to-date information concerning an environmental assessment requested in Reference 1 is attached. This information relates to the subject contract and to the Rockwell Seal Beach facility where P91-1 testing occurs.

None of the twenty materials listed are considered contract required. As you will note, the annual usage of these materials is extremely low - well below any current reporting quantities. Rockwell's pollution prevention efforts and goals mirror the requirements of the Pollution Prevention Act, Executive Order 12856, EPCRA, and the Federal Facilities Compliance Act. We are in the process of reviewing all of our Rockwell material specifications for listed chemicals and developing/procuring a substitute material, wherever possible. At the launch site (Vandenberg Air Force Base) we will hopefully use National Stock Number materials comparable to the materials we currently use.

Any questions regarding this matter should be directed to Dave Triplett (Rockwell Engineering - (310) 797-3683) or Mike Bimmer (Rockwell - Environmental, Safety and Industrial Hygiene - (310) 922-2042).

ROCKWELL INTERNATIONAL
SPACE SYSTEMS DIVISION

Kathleen M. Alarid
Contract Administrator
Satellite & Space Defense Systems

Enc: Environmental Data - P91-1 ARGOS Contract F04701-91-C-0090

cc:			
	Capt R. Lutz	SMC/CULM	w/enc.
	Capt B. Turner	SMC/CULM	w/enc.
	D. Tatum/Capt Story(ACO)	DCMAO, 841-SK32	w/enc.
	L. Literat, DCMAO	841-BA80	w/o enc.

ENVIRONMENTAL DATA - P91-1 ARGOS CONTRACT F04701-91-C-0090

PRODUCT NAME	CAS	CONSTITUENTS	ANNUAL QUANTITY IN #s	HOW USED	CONTRACT REQ. Y / N	SARA 313 Y / N	ODS EPA 17 Y / N
ROGLAZE A276			19.2	PAINT COATING USED ON SATELLITE	N		
	1330-20-7	XYLENE				Y	Y
	108-88-3	TOLUENE				Y	Y
	100-41-4	ETHYL BENZENE				Y	N
	108-10-1	METHYL ISOBUTYL KETONE				Y	Y
	5124-30-1	METHYLENE BIS (4-CYCLOHEXYLISOCYANATE)				N	N
	108-65-6	1-METHYOXY-2 PROPYL ACETATE				N	N
	4098-71-9	ISOPHORONE DIISOCYANATE				Y	N
ROGLAZE 9924A			17.4	WASH PRIMER USED ON SATELLITE	N		
	108-65-6	1-METHOXY-2-PROPYL ACETATE				N	N
	64-17-5	ETHYL ALCOHOL					
	78-92-2	SECONDARY BUTANOL				N	N
	11103-86-9	ZINC CHROMATE PIGMENT				Y	N
	88917-22-0	DIPROPYLENEGYLCOL METHYLETHERACETATE				N	Y
						N	N
	67-56-1	METHANOL				Y	N.
ROGLAZE 9924B			15.7	WASH PRIMER USED ON SATELLITE	N		
	108-65-6	1-METHOXY-2-PROPYL ACETATE				N	N
	88917-22-0	DIPROPYLENEGYLCOL METHYLETHERACETATE				N	N
	78-92-2	SECONDARY BUTANOL				Y	N
	64-17-5	ETHYL ALCOHOL				N	N
	7664-38-2	PHOSPHORIC ACID				Y	N
COSIL 4952			4.7	ADHESIVE USED TO BOND BLACK BOX TO SATELLITE	N		
	1344-28-1	ALUMINUM OXIDE				Y	N
		SILICONE RESIN				N	N
-2216 B/A PART A EPOXY HESIVE			5.3	ADHESIVE EPOXY USED TO BOND PARTS TO SATELLITE	N		
		AMINE TERMINATED POLYMER (TRADE SECRET)				---	—
	1332-58-7	KAOLIN				N	N
	1333-86-4	CARBON BLACK				N	N

Refer to Rockwell letter
95MA1013 dated 3-22-95

ENVIRONMENTAL DATA - P91-1 ARGOS CONTRACT F04701-91-C-0090

PRODUCT NAME	CAS	CONSTITUENTS	ANNUAL QUANTITY IN #s	HOW USED	CONTRACT REQ. Y / N	SARA 313 Y / N	ODS EPA 17 Y / N
-2216 B/A PART B			5.6	ADHESIVE EPOXY USED TO BOND PARTS TO SATELLITE	N		
	25068-38-6	EPOXY RESIN				N	N
	1332-58-7	KAOLIN				N	N
4155 SILICONE PRIMER			13.5	PRIMER USED ON SATELLITE	N		
	8002-05-9	PETROLEUM DISTILLATE				N	N
		PROPRIETARY COMPONENT (TRADE SECRET)				---	---
E-3010 PART A			7.5	POTTING COMPOUND USED IN INSTALLING INSERTS ON SATELLITE	N		
		PROPRIETARY BLEND OF EPOXY				---	---
	1309-64-4	ANTIMONY OXIDE				N	N
	65997-17-3	SODALIME BOROSILICATE GLASS				N	N
E-3010 PART B			7.5	POTTING COMPOUND USED IN INSTALLING INSERTS ON SATELLITE	N		
	111-40-0	DIETHYLENETRIAMINE				N	N
3G/L0-1 THERMAL CONTROL ATING			3.1	USED AS COATING ON BACKSIDE SOLAR PANELS	N		
	9016-00-6	METHYL SILICONE				N	N
	1314-13-2	ZINC OXIDE				N	N
9 SOLVENT USED WITH 3G/L0-1			1.7	USED AS COATING ON BACKSIDE SOLAR PANELS	N		
	108-88-3	TOLUENE				Y	Y
	1330-20-7	XYLENE				Y	Y
	67-63-0	ISOPROPANOL				Y	N
	71-36-3	BUTANOL				Y	N
	123-86-4	BUTYL ACETATE				N	N

Refer to Rockwell letter
95MA1013 dated 3-22-95

ENVIRONMENTAL DATA - P91-1 ARGOS CONTRACT F04701-91-C-0090

PRODUCT NAME	CAS	CONSTITUENTS	ANNUAL QUANTITY IN #s	HOW USED	CONTRACT REQ Y / N	SARA 313 Y / N	ODS EPA 17 Y / N
YSOL EA 934 NA PART A			13.3	EPOXY USED TO BOND PARTS TO SATELLITE	N		
	28064-14-4	POLYMER OF EPICHLOROHYDRIN, PHENOL FORMALDEHYDE NOVOLAC RESIN				N	N
	5026-74-4	4-GLYCIDYLOXY-N,N,DIGLYCIDYL-ANILINE				N	N
	7429-90-5	ALUMINUM POWDER				Y	N
	112945-52-5	SILICA				N	N
YSOL EA 934 NA PART B			8.0	EPOXY USED TO BOND PARTS TO SATELLITE	N		
	68082-29-1	POLYAMIDE RESIN				N	N
	111-40-4	DIETHYLENE-TRIAMINE				N	N
	112-24-3	TRIETHYLENE-TETRAMINE				N	N
ETONE	67-64-1		1.7	USED AS OPTICAL CLEANER	N	Y	N
TRIC ACID	7697-37-2		6.3	USED AS PART CLEANER	N	Y	N
OPROPYL ALCOHOL	67-63-0		13.0	USED FOR GENERAL PART CLEANING	N	Y	N'
ODINE 1200S			2.0	CHEMFILM USED FOR TOUCH UP COATING ON SATELLITE	N		
	1333-82-0	CHROMIC ACID, DRY				N	Y
	16923-95-8	POTASSIUM FLUOZIRCONATE				N	N
	13746-66-2	POTASSIUM FERRICYANIDE				N	N
	7681-49-4	SODIUM FLUORIDE				N	N
	14075-53-7	POTASSIUM FLUOBORATE				N	N
ETHYL ETHYL KETONE	78-93-3		1.7	USED FOR GENERAL CLEANING OF PARTS	N	Y	Y
,1-TRICHLOROETHANE	71-55-6		2.8	USED FOR PARTS CLEANING	N	Y	Y
STER SOLDER			2.0	USED FOR SOLDERING ELECTRICAL CONNECTORS	N		
	7440-31-5	TIN				N	N
	7439-92-1	LEAD				Y	Y
	7440-36-0	ANTIMONY				Y	N
	7440-69-9	BISMUTH				N	N
	7440-43-9	CADMIUM				Y	N
	7440-22-7	SILVER				Y	N

Refer to Rockwell letter
95MA1013 dated 3-22-95

Space Systems Division
Rockwell International Corporation
12214 Lakewood Boulevard
PO Box 7009
Downey, CA 90241-7009

Rockwell Aerospace

April 1, 1996

In Reply Refer to 96MA1023

Space & Missile Systems Center
3550 Aberdeen Avenue, SE
Kirtland AFB, NM 87117-5776

Attention: Capt. G. Settles, TELS

Subject: P91-1 ARGOS Contract F04701-91-C-0090, Submittal of Environmental Data

Reference:
1) Air Force Letter from Major Lutz, dated 19 January 1996
2) Rockwell International Letter 95MA1013 to SMC/CULK, "P91-1 ARGOS Contract F04701-91-C-0090, Submittal of Environmental Data," dated 23 March 1995

The environmental data requested by referenced 1 is enclosed. This information relates to the subject contract and to the Rockwell Anaheim facility, where 3 electronic boxes are being developed. The data for the Seal Beach facility was provided by reference 2. Of the 20 materials listed in reference 2, only Acetone, MEK, and isopropyl alcohol are planned for use at VAFB. The usage of these materials is extremely low - well below any current reporting quantities. Class II ODSs (ozone depleting substances) are not planned for use at any facility on the ARGOS Program.

Rockwell International Corporation
Space Systems Division

F Rotter

F. H. Rotter
P91-1 Program Manager

Enclosure: Attachment 1 — Environmental Data on P91-1 Contract F04701-91-C-0090 (Anaheim)

cc:
D. Chism, Aerospace w/encl
Capt. H. Ennulat, TELS w/encl
Major R. Lutz/CULM w/encl
M. Pearson, TEK w/encl

ENVIRONMENTAL DATA ON P91-1 CONTRACT F04701-91-C-0090 (ANAHEIM)

* Annual Qty in lbs derived fôrm estimated weekly usage on P91 Program

PRODUCT NAME	CAS. No.	CONSTITUENTS	Annual Qty in Lbs	HOW USED (Process)	Contr. REQ. Y/N	Class 1 Y/N	Class II Y/N	ODS EPA 17 Y/N
Isopropyl Alcohol	67-63-0		75	Component & Board Cleaning	N	N	N	N
Naphtha			15					
1.1.1-trichloroethane (To be eliminated in Fy97)	71-55-6		10		N	Yes	N	N
Solethane 113			4	Conformal Coating				
	584-84-9	Toluene Diiscocyanate			N	N	N	Yes
C-113-3000 Curing Agent	8001-79-4	Ricinus Oil	1		N	N	N	N
Bar solder			5	Tinning (Solder pot)				
	7429-90-5	Aluminum (dust)			N	N	N	N
	7440-36-0	Antimony			N	N	N	Yes
	7440-38-2	Arsenic			N	N	N	N
	7440-50-8	Copper			N	N	N	N
	7440-13-9	Cadmium			N	N	N	Yes
	7439-92-1	Lead			N	N	N	Yes
	7440-02-0	Nickel			N	N	N	N
	7440-22-4	Silver			N	N	N	Yes
	7440-31-5	Tin			N	N	N	N
Kester 197 Flux			3	Hand Soldering &				
Kester 185 Flux	8050-09-7	Rosin		Mass Soldering	N	N	N	N
	8005-64-2	Turpentine			N	N	N	N
Kester Core Solder	7439-92-1	Lead			N	N	N	N
Fluorinert FC5312	86508-42-1	(PerFluorocompound, C5-18)	22	Mass Soldering (Vapor Phase)	N	N	N	N
SF2	86508-42-1	(PerFluorocompound, C5-18)	50		N	N	N	N
Freon TMS (Eliminated in Fy96)								
	76-13-1	Trichlorotrifluoroethane (Freon TF)	N/A		N	N	N	N
	67-56-1	Methanol			N	N	N	N
	75-52-5	Nitromethane			N	N	N	N

ENVIRONMENTAL DATA ON P91-1 CONTRACT F04701-91-C-0090 (ANAHEIM)

* Annual Qty in lbs derived fom estimated weekly usage on P91 Program

PRODUCT NAME	CAS. No.	CONSTITUENTS	Annual Qty in Lbs	HOW USED (Process)	Contr. REQ. Y/N	Class 1 Y/N	Class II Y/N	ODS EPA 17 Y/N
Multicore Solder Paste			3	Solder Paste Screen Printing				
RM92AAS90	427604	(Lead & Silver)			N	N	N	Yes
AB0120-022 Type II Class 2 (Recipe #63)Scotchweld 2216/COS			10	Component Bonding				
	25068-38-6	Diglycidyl Ether of Bisphenol-A			N	N	N	N
	106-89-8	Epichlorohydrin (trace)			N	N	N	N
	103-11-7	2-Ethyl-Hexyl-Acrylate (trace)			N	N	N	N
	1330-20-7	Xylene (<.01%)			N	N	N	Yes
	1333-86-4	Carbon Black			N	N	N	N
	126-73-8	Tributyl Phosphate			N	N	N	N
	7631-86-9	Silicon Dioxide			N	N	N	N
567-0073-001 (Flexbond 442)			5					
	101-68-8	4,4'Diphenylmethane Diisocyanate			N	N	N	N
	1344-28-1	Aluminum oxide			N	N	N	N
	7631-86-9	Silicone Dioxide			N	N	N	N
Silver Epoxy Adh. 56C/CAT 9 FP Recipe #2)			0.2					
	7440-22-4	Silver Powder			N	N	N	N
	25068-38-6	Diglycidyl Ether of Bisphenol - A			N	N	N	N
	106-89-8	Epichlorohydrin			N	N	N	N
	7440-22-4	Ethylene Amine			N	N	N	N

* Annual Qty in lbs derived fôrm estimated weekly usage on P91 Program

PRODUCT NAME	CAS. No.	CONSTITUENTS	Annual Qty in Lbs	HOW USED (Process)	Contr. REQ. Y/N	Class 1 Y/N	Class II Y/N	ODS EPA 17 Y/N
Adhesive Scot-2216/AF-44 FP (Recipe #17)			5	Encapsulating Connectors				
	111-76-2	2-Butoxyethanol			N	N	N	N
	108-88-3	Toluene			N	N	N	Yes
	64742-89-8	Aliphatic Petreoleum Distillate			N	N	N	N
	8052-41-3	Aliphatic Petreoleum Distillate			N	N	N	N
	71-36-3	N-Butyl Alcohol			N	N	N	N
	67-64-1	Acetone			N	N	N	N
	74-98-6	Propane			N	N	N	N
	106-97-8	Butane			N	N	N	N
Polyimide Label Wornol ink (Hysol M-O-N-C Black ME 1009)			1	Identification				
	80-05-7	Bisphenol A resin			N	N	N	N
	112-15-2	Diethylene Glycol Monoethylether Acetate			N	N	N	N
Rub-on characters					N	N	N	N
TT-E-527D Black 37038 Org. Coating			0.1	Touchup Painting of Chassis				
	1317-61-9	Black Iron Oxide			N	N	N	N
	14807-96-6	Magnesium Silicate			N	N	N	N
	14808-60-7	Silica, Crystalline-quarts			N	N	N	N
	6052-41-3	Mineral Spirits			N	N	N	N
	64742-95-6	Super Hi-Flash (S-100)			N	N	N	N
	108-65-6	Methoxy-2-Propanol acetate			N	N	N	N
	14807-96-6	Magnesium Silicate			N	N	N	N

December 7, 1994

Lt. D. Ziegler
SMC/CULM
160 Skynet St., Suite 1536A
Los Angeles AFB, CA 90245-4683

Attn: Lt. D. Ziegler

Subj: Request for Environmental Data Response

Lt. Ziegler,

In response to Captain R. Lutz's request for environmental data I have generated a matrix identifying the potentially hazardous materials used by the NRL ARGOS GIMI, HIRAAS and USA experiments. See attachment 1.

Should any additional information on this subject be required, please do not hesitate to contact the undersigned at (202) 404-7889.

Regards,

Larry Scoggin
Larry Scoggin
Praxis, Inc.
NRL ARGOS Coordination Office

Attachment:
ARGOS GIMI, HIRAAS, USA Environmental Data Matrix

cc:
G. Fritz, NRL ARGOS Coordination Office
G. Carruthers, NRL GIMI Principal Investigator
R. McCoy, NRL HIRAAS Principal Investigator
K. Wood, NRL USA Principal Investigator

Attachment I

ARGOS GIMI, HIRAAS, USA Environmental Data Response

Class I ODSs:

None have been identified as being used at the NRL by the ARGOS GIMI, HIRAAS and USA experiments.

EPA List of 17 Toxins:

Project	Chemical Name	CAS Number (3)	Quantity Used (lb) (4)	Usage Description	Contract Rqmt
GIMI, HIRAAS, USA	Lead (2)	7439-92-1	< .5	Tin lead solder used in the assembly of electronic Printed Circuit Boards and wire harness soldering	Yes (5)
GIMI	Toluene (1)	108-88-3	< .1	Solvent used to thin conformal coating prior to spray application	No
GIMI, HIRAAS, USA	Nickel (2)	7440-02-0	< .25	Used as a coating or bonding layer on electronic components	Yes (5)

EPCRA 313 Chemicals:

Project	Chemical Name	CAS Number (3)	Quantity Used (lb) (4)	Usage Description	Contract Rqmt
GIMI, USA	Acetone (1)	67-64-1		Cleaning solvent	No
GIMI	Ammonia (2)	7664-41-7	< 1	Heat pipe heat transfer medium	No
GIMI, HIRAAS, USA	Copper (2)	7440-50-8	GIMI < 10 HIRAAS < 5 USA < 5	Printed Circuit Board circuitry, wires, cable harnesses, various mechanical pieces	Yes (5)
GIMI, HIRAAS, USA	Lead (2)	7439-92-1	< .5	Tin/lead solder used in the assembly of electronic Printed Circuit Boards and wire harness soldering	Yes (5)
GIMI, HIRAAS, USA	Nickel (2)	7440-02-0	<.25	Used as a coating or bonding layer on electronic components	Yes (5)
GIMI, HIRAAS, USA	Silver (2)	7440-22-4	<.25	Protective wire coating	Yes (5)

(1) This chemical has been identified as being used at the NRL by the experiment during either assembly fabrication and cleaning or experiment testing. These chemicals will not be delivered to Rockwell.

(2) This chemical has been identified as being used in the fabrication of materials or assemblies used at the NRL by the experiment. These chemicals form part of the experiment and will be delivered to Rockwell.

(3) CAS number taken from N. R. Keegan, LISTING OF "EXTREMELY HAZARDOUS CHEMICALS", Memorandum, 8 SEPT 94.

(4) Weight is estimated and reflects the total per experiment.

(5) Contract requirement is defined here as a requirement imposed on a vendor or supplier as necessary to meet a military specification or requirement, or NASA specification or requirement. These requirements are generally imposed on vendors of materials used in the manufacturing of electronic components or assemblies.